

1.1 Background

Rapid visual screening of buildings for potential seismic hazards, as described herein, originated in 1988 with the publication of the FEMA 154 Report, *Rapid Visual Screening of Buildings for Potential Seismic Hazards: A Handbook*. Written for a broad audience ranging from engineers and building officials to appropriately trained nonprofessionals, the *Handbook* provided a “sidewalk survey” approach that enabled users to classify surveyed buildings into two categories: those acceptable as to risk to life safety or those that may be seismically hazardous and should be evaluated in more detail by a design professional experienced in seismic design.

During the decade following publication of the first edition of the FEMA 154 *Handbook*, the rapid visual screening (RVS) procedure was used by private-sector organizations and government agencies to evaluate more than 70,000 buildings nationwide (ATC, 2002). This widespread application provided important information about the purposes for which the document was used, the ease-of-use of the document, and perspectives on the accuracy of the scoring system upon which the procedure was based.

Concurrent with the widespread use of the document, damaging earthquakes occurred in California and elsewhere, and extensive research and development efforts were carried out under the National Earthquake Hazards Reduction Program (NEHRP). These efforts yielded important new data on the performance of buildings in earthquakes, and on the expected distribution, severity, and occurrence of earthquake-induced ground shaking.

The data and information gathered during the first decade after publication (experience in applying the original *Handbook*, new building earthquake performance data, and new ground shaking information)

have been used to update and improve the rapid visual screening procedure provided in this second edition of the FEMA 154 Report, *Rapid Visual Screening of Buildings for Potential Seismic Hazards: A Handbook*. The revised RVS procedure retains the same framework and approach of the original procedure, but incorporates a revised scoring system compatible with the ground motion criteria in the FEMA 310 Report, *Handbook for Seismic Evaluation of Buildings—A Prestandard* (ASCE, 1998), and the damage estimation data provided in the recently developed FEMA-funded HAZUS damage and loss estimation methodology (NIBS, 1999). As in the original *Handbook*, a Data Collection Form is provided for each of three seismicity regions: low, moderate, and high. However, the boundaries of the low, moderate, and high seismicity regions in the original *Handbook* have been modified (Figure 1-1), reflecting new knowledge on the expected distribution, severity, and occurrence of earthquake ground shaking, and a change in the

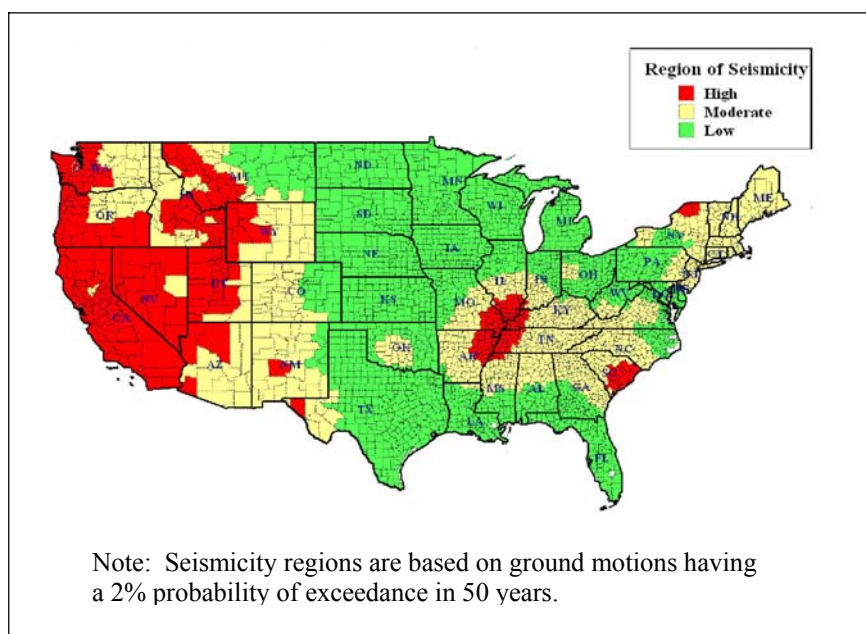


Figure 1-1 High, moderate, and low seismicity regions of the conterminous United States. A different RVS Data Collection Form has been developed for each of these regions. Enlarged maps are available in Appendix A.

recurrence interval considered, from a 475-year average return period (corresponding to ground motions having a 10% probability of exceedance in 50 years) to a 2475-year average return period (corresponding to ground motions having a 2% probability of exceedance in 50 years).

This second edition of the FEMA 154 *Handbook* has been shortened and focused to facilitate implementation. Other improvements include:

- guidance on planning and managing an RVS survey, including the training of screeners and the acquisition of data from assessor files and other sources to obtain more reliable information on age, structural system, and occupancy;
- more guidance for identifying the structural (lateral-load-resisting) system in the field;
- the use of interior inspection or pre-survey reviews of building plans to identify (or verify) a building's lateral-load-resisting system;
- updated Basic Structural Hazard Scores and Score Modifiers that are derived from analytical calculations and recently developed HAZUS fragility curves for the model building types considered by the RVS methodology;
- the use of new seismic hazard information that is compatible with seismic hazard criteria specified in other related FEMA documents (see Section 1.4 below); and
- a revised Data Collection Form that provides space for documenting soil type, additional options for documenting falling hazards, and an expanded list of occupancy types.

1.2 Screening Procedure Purpose, Overview, and Scope

The RVS procedure presented in this *Handbook* has been formulated to identify, inventory, and rank buildings that are potentially seismically hazardous. Developed for a broad audience that includes building officials and inspectors, government agencies, design professionals, private-sector building owners (particularly those that own or operate clusters or groups of buildings), faculty members who use the RVS procedure as a training tool, and informed appropriately trained, members of the public, the RVS procedure can be implemented relatively quickly and inexpensively to develop a list of

potentially hazardous buildings without the high cost of a detailed seismic analysis of individual buildings. If a building receives a high score (i.e., above a specified cut-off score, as discussed later in this *Handbook*), the building is considered to have adequate seismic resistance. If a building receives a low score on the basis of this RVS procedure, it should be evaluated by a professional engineer having experience or training in seismic design. On the basis of this detailed inspection, engineering analyses, and other detailed procedures, a final determination of the seismic adequacy and need for rehabilitation can be made.

During the planning stage, which is discussed in Chapter 2, the organization that is conducting the RVS procedure (hereinafter, the “RVS authority”) will need to specify how the results from the survey will be used. If the RVS authority determines that a low score automatically requires that further study be performed by a professional engineer, then some acceptable level of qualification held by the inspectors performing the screening will be necessary. RVS projects have a wide range of goals and they have constraints on budget, completion date and accuracy, which must be considered by the RVS authority as it selects qualification requirements of the screening personnel. Under most circumstances, a well-planned and thorough RVS project will require engineers to perform the inspections. In any case, the program should be overseen by a design professional knowledgeable in seismic design for quality assurance purposes.

The RVS procedure in this *Handbook* is designed to be implemented without performing structural analysis calculations. The RVS procedure utilizes a scoring system that requires the user to (1) identify the primary structural lateral-load-resisting system; and (2) identify building attributes that modify the seismic performance expected of this lateral-load-resisting system. The inspection, data collection, and decision-making process typically will occur at the building site, taking an average of 15 to 30 minutes per building (30 minutes to one hour if access to the interior is available). Results are recorded on one of three Data Collection Forms (Figure 1-2), depending on the seismicity of the region being surveyed. The Data Collection Form, described in greater detail in Chapter 3, includes space for documenting building identification information, including its use and size, a photograph of the building, sketches, and documentation of pertinent data related to seismic performance, including the development of a

numeric seismic hazard score. The scores are based on average expected ground shaking levels for the seismicity region as well as the seismic design and construction practices for that region¹. Buildings may be reviewed from the sidewalk without the benefit of building entry, structural drawings, or structural calculations. Reliability and confidence in building attribute determination are increased, however, if the structural framing system can be verified during interior inspection, or on the basis of a review of construction documents.

The RVS procedure is intended to be applicable nationwide, for all conventional building types. Bridges, large towers, and other non-building structure types, however, are not covered by the procedure. Due to budget or other constraints, some RVS authorities may wish to restrict their RVS to identifying building types that they consider the most hazardous, such as unreinforced masonry or nonductile concrete buildings. However, it is recommended, at least initially, that all conventional building types be considered, and that elimination of certain building types from the screening be well documented and supported with office calculations and field survey data that justify their elimination. It is possible that, in some cases, even buildings designed to modern codes, such as those with configurations that induce extreme torsional response and those with abrupt changes in stiffness, may be potentially hazardous.

¹ Seismic design and construction practices vary by seismicity region, with little or no seismic design requirements in low seismicity regions, moderate seismic design requirements in moderate seismicity regions, and extensive seismic design requirements in high seismicity regions. The requirements also vary with time, and are routinely updated to reflect new knowledge about building seismic performance.

Figure 1-2 Data Collection Forms for the three designated seismicity regions (low, moderate, and high).

1.3 Companion FEMA 155 Report

A companion volume to this report, *Rapid Visual Screening of Buildings for Potential Seismic Hazards: Supporting Documentation (second edition)* (FEMA 155) documents the technical basis for the RVS procedure described in this *Handbook*, including the method for calculating the Basic Structural Scores and Score Modifiers. The FEMA 155 report (ATC, 2002) also summarizes other information considered during development of this *Handbook*, including the efforts to solicit user feedback and a FEMA 154 Users Workshop held in September 2000. The FEMA 155 document is available from FEMA by

dialing 1-800-480-2520 and should be consulted for any needed or desired supporting documentation.

1.4 Relationship of FEMA 154 to Other Documents in the FEMA Existing Building Series

The FEMA 154 *Handbook* has been developed as an integral and fundamental part of the FEMA report series on seismic safety of existing buildings. It is intended for use by design professionals and others to mitigate the damaging effects of earthquakes on existing buildings. The series includes:

- FEMA 154 (this handbook), which provides a procedure that can be rapidly implemented to identify buildings that are potentially seismically hazardous.
- FEMA 310, *Handbook for Seismic Evaluation of Buildings—A Prestandard* (ASCE, 1998), which provides a procedure to inspect in detail a given building to evaluate its seismic resisting capacity (an updated version of the FEMA 178 *NEHRP Handbook for the Seismic Evaluation of Existing Buildings* [BSSC, 1992]). The FEMA 310 Handbook is ideally suited for use on those buildings identified by the FEMA 154 RVS procedure as potentially hazardous.

FEMA 310 is expected to be superseded in 2002 by ASCE 31, a standard of the American Society of Civil Engineers approved by the American National Standards Institute (ANSI). References in this *Handbook* to FEMA 310 should then refer to ASCE 31.

- FEMA 356, *Prestandard and Commentary for the Seismic Rehabilitation of Buildings* (ASCE, 2000), which provides recommended procedures for the seismic rehabilitation of buildings with inadequate seismic capacity, as determined, for example, by a FEMA 310 (or FEMA 178) evaluation. The FEMA 356 Prestandard is based on the guidance provided in the FEMA 273 *NEHRP Guidelines for the Seismic Rehabilitation of Buildings* (ATC, 1997a), and companion FEMA 274 *Commentary on the NEHRP Guidelines for the Seismic Rehabilitation of Buildings* (ATC, 1997b).

1.5 Uses of RVS Survey Results

While the principal purpose of the RVS procedure is to identify potentially seismically hazardous buildings needing further evaluation, results from RVS surveys can also be used for other purposes. These include: (1) ranking a community's (or agency's) seismic rehabilitation needs; (2) designing seismic hazard mitigation programs for a community (or agency); (3) developing inventories of buildings for use in regional earthquake damage and loss impact assessments; (4) planning postearthquake building safety evaluation efforts; and (5) developing building-specific seismic vulnerability information for purposes such as insurance rating, decision making during building ownership transfers, and possible triggering of remodeling requirements during the permitting process. Additional discussion on the use of RVS survey results is provided in Chapter 4.

1.6 How to Use this Handbook

The *Handbook* has been designed to facilitate the planning and execution of rapid visual screening. It is assumed that the RVS authority has already decided to conduct the survey, and that detailed guidance is needed for all aspects of the surveying process. Therefore, the main body of the *Handbook* focuses on the three principal activities in the RVS: planning, execution, and data interpretation. Chapter 2 contains detailed information on planning and managing an RVS. Chapter 3 describes in detail how the Data Collection Form should be completed, and Chapter 4 provides guidance on interpreting and using the results from the RVS. Finally, Chapter 5 provides several example applications of the RVS procedure on real buildings.

Relevant seismic hazard maps, full-sized Data Collection Forms, including a Quick Reference Guide for RVS implementation, guidance for reviewing design and construction drawings, and additional guidance for identifying a building's seismic lateral-load-resisting system from the street are provided in Appendices A, B, C, and D, respectively. Appendix E provides additional information on the building types considered in the RVS procedure, and Appendix F provides an overview of earthquake fundamentals, the seismicity of the United States, and earthquake effects.